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Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Sweet Clover

(*Melilotus*.)

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FOREWORD

On account of the recent interest arising in relation to sweet clover as a farm crop, it has been thought desirable to make a study of the plant, its distribution, adaptation, manurial and feeding value, and management. The following article gives a consideration of this study. Samples were taken for ascertaining its feeding value, manurial value, digestibility, proper stages of cutting for hay, total yield of nutrients, etc., and the results of these tests are herein given. This publication is not for the purpose of urging the adoption of this plant as a crop, but simply has for its object the summing up of the estimate in which it is held at the present time, and the presentation of a short description of its nature, distribution, habits, and management in so far as these are known at this date.

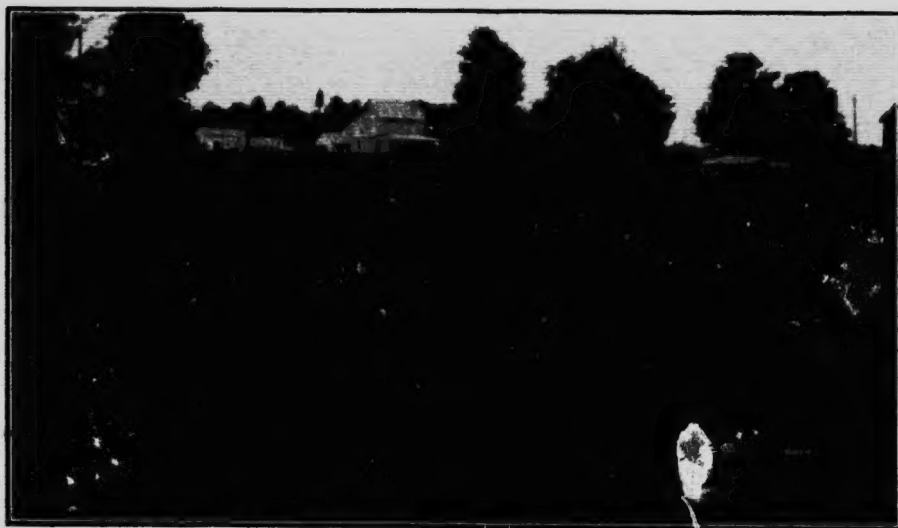


Fig. 1. A meadow of Sweet Clover on June 5th. The growth is about two feet high and at about the proper stage for cutting for hay, the flower buds just beginning to appear. Note the alfalfa-like appearance, from which plant it is not easy to distinguish Sweet Clover up to this stage.

PROGRESS IN THE SCIENCE AND PRACTICE OF AGRICULTURE.

It is a matter of common knowledge that in the history of all lines of human thought and effort changes in attitude and direction have always occurred from time to time. These changes have in most cases been quite gradual, for man is, fortunately, endowed with the characteristic of conservatism; still, in many cases, these changes have taken place rapidly. We need not, for instance, go far into the realm of science to find examples of the working of this law in scientific thought and effort, for the history of Science is rich in instances of this kind. At one time, for example, it was held by men of Science, that gold could be made artificially; that water could be changed into earth or air by the application of heat or the extraction of moisture, respectively; that a vessel full of earth could hold as much water as it could when no earth was in it; and many other, to us, equally absurd things. We now hold different beliefs in relation to the foregoing. A few years ago, also, such a cause of ill-health as bacteria, was a thing unheard of, but now it is universally accepted that some of the worst forms of human ills are the result of the inroads of these microscopic organisms. And so we might mention scores of like cases; but we need not quote history nor confine ourselves to any one phase of human interest. Socially, morally, scientifically, industrially, we have changed, and are changing, in our own day and generation—and almost imperceptibly, in some cases, noticeably in others. And in the science and practice of agriculture we have no exception to the general rule.

Change in most cases denotes progress, and in agriculture we are changing and, on the whole, progressing. Through investigation, instruction, precept and example, we are learning how better to grapple with the various problems found in the different fields of agriculture. Soils and crops and their management, the nature and use of fertilizers, the breeding and rearing of animals, the construction of farm buildings, the utilization of farm power, the transportation and marketing of our products, are all now more fully and intelligently understood than ever before, and we believe the end of our progress in matters agricultural is not yet in sight.

One field of agriculture, in which considerable progress has been made and is being made, is that of crops. By a system of breeding, selection and exploration, better kinds and sorts of the different crops have been reared, isolated or discovered by the scientist and experimenter, varieties which are hardy and best yielders, resistant to disease and pest, and which not only enrich or improve the soil on which they are grown, but often at the same time, furnish a maximum of wholesome and nutritious food for man and beast. These improved varieties are available to the farmer of the present day, and as work along these lines is still being carried on, other and better varieties will no doubt appear in the future, to take the place of those now being cultivated, or those which are just being introduced.

AN OLD PLANT IN A NEW GUISE?

A plant which is beginning to attract considerable attention at the present time in this province is the one commonly known as Sweet Clover. This plant is well known and by many is deemed a bad and noxious weed where it grows—and it grows almost universally—but there is now evidence which seems to indicate that it will eventually be turned to a very desirable and useful purpose on the farms of Ontario.

Sweet Clover is known under several names, such as Bokh Clover, melilot or melilotus, bee clover, honey clover, mountain clover, giant clover, wild alfalfa, etc., and consists of several species. These species differ botanically and in their geographical distribution.

Species:

(a) *White Sweet Clover* (*Melilotus alba*) usually called *Sweet Clover* because it is the commonly occurring and most widely distributed species, is a biennial, producing its seed the second season. It is an erect branching plant having much the appearance of alfalfa in its early stages of growth, and from which it is difficult to distinguish, until the bloom is produced or by its somewhat bitter taste and strong, vanilla-like odour when cut and curing. It grows 2 to 2½ feet high the first season and stores up reserve food for its second season's growth, but produces no bloom or seed. The second season, it produces its bloom, matures its seed and then dies. The second season's growth is more open and stemmy, more sparsely supplied with leaves, and attains often to a height of 8 to 10 feet. At this stage it is very bushy, woody and unsightly. The flowers are white and produced in long racemes, those at the base opening first, often weeks before those at the tip, and maturing their seed long before, so that the phenomenon of having ripe seed and bloom on the same plant, at one and the same time, such as in the common Shepherd's purse, is present. The stems get very fibrous or woody after blooming begins, and more so as the season advances. This is the plant which is found growing so commonly along roadsides, railway tracks, in vacant lots, by the sides of ditches and in cuts, and other waste places.

(b) *Yellow Sweet Clover* (*Melilotus officinalis*) is a biennial, with the same habit of growth as the white sweet clover except that it is not quite so stemmy nor does it grow quite so large. These two species are hard to distinguish from each other except when in bloom, when it is rendered easy, the *officinalis* producing a yellow-coloured flower instead of one of a white colour. This species is not so widely distributed in Ontario as the former, and blooms one or two weeks earlier in the season.

(c) *Melilotus indica*, a small yellow-flowered annual, with erect growth and early flowering. It lasts only one season, producing its growth and seed all in one year. It is widely distributed. It is reported in California and in some of the Southern States where it has found favour as a cover crop for orchards.

(d) *Melilotus Azureus*, a purple-flowered annual found in the Southern States and in Switzerland.

(e) *Melilotus parviflora*, a yellow-flowered kind found in South Africa, South America and Australia.

HISTORY.

Sweet Clover is a native of Central Asia. It is known to have been growing in the region of the Mediterranean Sea for the past 20 centuries or more and has, therefore, long been known. Its introduction into America perhaps occurred in the early part of the eighteenth century, when it was brought in probably by settlers from Europe, either intentionally or accidentally, or perhaps conveyed in shipments of merchandise from countries where it occurred, for it is reported as having been in some cases first noticed in the vicinity of seaports.

DISTRIBUTION.

Although at one time, according to its origin, Sweet Clover was confined to the central part of Asia, it is now to be found in all parts of the world. It, therefore, seems to be a very adaptable plant. In fact, it does accustom itself to nearly every kind of environment, for it is to be found growing luxuriantly under all conditions of climate, from the extremely hot to the very cold, and on all types and nearly all kinds of soil. All the states of the American Union report it as occurring within their boundaries, particularly the two species—*alba* and *officinalis*; and from correspondence and observation we find these same two species growing in nearly all of the settled parts of Canada, the *alba* being particularly widely disseminated and commonly occurring. About the only places where this plant does not seem to take root and thrive well, are those which possess an extremely cold climate, practically beyond the limit of vegetation, or those where the soil is sour or acid in nature, or, on the other hand, is excessively charged with alkali.

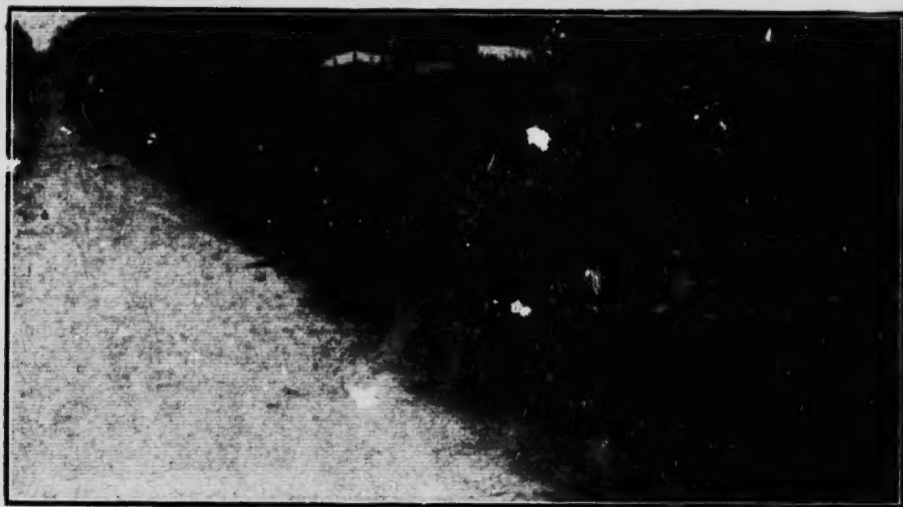


Fig. 2. On the roadside—a favorite habitat of Sweet Clover.

IS IT A WEED?

Various authorities have defined a weed as "a plant out of place," "a plant that is not wanted," or as "any plant growing in cultivated ground to the injury of the crop or the desired vegetation, or to the disfigurement of the place." Accepting these definitions, it can easily be seen that Sweet Clover is, or might be, a weed. A corn plant growing in the alfalfa field or on the lawn would be a weed and just as truly would alfalfa be a weed if found growing among the wheat or if it found its way into the perennial border. There is no doubt that the general impression throughout the Province of Ontario is that Sweet Clover is a weed, and, what is more, is in most minds, nothing but a weed. This opinion has gained acceptance primarily, I think, from the prevalence of the plant in waste and vacant places, along roadsides and railway tracks, in cuts, on ditch banks and in other noticeable places, places where it is particularly neglected in most cases, and allowed to grow to that tall and unsightly state which it attains in its second or seed-

producing year. Its first year's growth, and the same luxuriant alfalfa-like growth produced in the first part of the second year, is very rarely noted, if at all. This, coupled with the general observation that where other foliage is abundant, Sweet Clover is not relished by our domestic animals, has stamped this plant as a weed, and from this has sprung up a general and more or less deep-rooted prejudice, which has blinded the general farming community to the probably natural function which this plant is performing in these waste and neglected spots, or to the possibility of it becoming an acceptable and valuable farm crop, finding a place in the regular farm rotation. That it is a weed, as it now largely occurs, is without question, just as much so as wild mustard, sow-thistle or any of the other numerous plants of this same category. But it is not a noxious weed, nor can it be classed as such, for it is seldom, if ever, seen encroaching into regularly cultivated areas, except where some seed may have found its way into the regular seed sown, as sometimes has happened in the case of clover or alfalfa, from the seed of which the seed of Sweet Clover is not easily distinguished, and in which the latter has been known to have been occasionally present as an adulterant. Moreover, it is not a persistent plant, being a biennial, and can for this reason be easily destroyed by merely preventing it from producing seed. Neither is it a plant which can stand severe competition from other classes of plants, and thus it is that it is usually found growing in the wild state in waste places only, places where most other plants refuse to grow until after the Sweet Clover has paved the way for them by improving the fertility of that soil.

AGRICULTURAL VALUE.

As to the agricultural value of Sweet Clover, there is abundant evidence in its favour from nearly every quarter of the globe. In Ontario it has been known for the past twenty-three years as perhaps possessing some value as a farm crop; and indeed in the years 1891-1896 experiments were conducted with this plant, but these had to do largely with it in regard to comparative yield of green fodder, and no attempts were made to find its value as a green manure, as a pasture crop, or for other agricultural purposes. It was discarded as "a very coarse plant and the hay not relished by animals." However, as a result of more recent observation, mainly by practical farmers, it appears to have decided agricultural value, and along several lines, for Ontario farms; and from accounts from foreign countries, this value is beyond experimental stages in many places, and in these countries Sweet Clover occupies a prominent place among the general crops of the farm. (For evidence to this effect, see Appendix.)

AS A HAY AND PASTURE CROP.—For the production of hay, and for utilization as a pasturage, Sweet Clover does not at the present time occupy the position that some of the grasses and common legumes do, although it is in many cases successfully used for both purposes. On further acquaintance it may become, however, just as favourably looked upon and as widely used as any of those plants now in common use for these purposes. As we shall presently see, it certainly, at least compares very favourably in composition with the other legumes now so extensively used.

For hay-making the Yellow Sweet Clover (*melilotus officinalis*) is prized more highly than the White variety (*melilotus alba*). The Yellow is superior to the White in this respect, because of its finer stems and greater production of leafage, making thereby a more succulent and less fibrous or woody feed than the latter—which is, of course, of decided advantage in that it will be more thoroughly relished, more

completely consumed and more highly digested. It must not be overlooked, however, that the White variety is the more vigorous grower, the greater yielder, and the more widely adaptable. These factors tend to give it a decided advantage over the Yellow sort.

All domestic animals—horses, cattle, sheep and swine—thrive well on Sweet Clover after they have once acquired a taste for it. This plant contains a bitter principle, coumarin, most abundant in the blossom, which seems to be distasteful to most animals at first, but which they come to relish after a time. The agreeable odour of Sweet Clover, especially noticeable when cut and curing, and something akin to the smell of vanilla, is due to the presence of this substance. Some strains of Sweet Clover contain less of coumarin than others, and if it is found necessary it will be quite possible, no doubt, by selection and breeding, to produce a strain of this plant which will contain not enough of this substance to give it that objectionable taste or smell which makes animals at first refuse to eat it.

There is some conflict of evidence, however, in regard to the usefulness of Sweet Clover as a pasture crop. Some people claim that they cannot induce their animals to eat it, even by starvation; but there are abundant cases reported from all over the world where this plant is being used extensively as a forage crop. And there are not wanting farmers in our own Province who are using this plant with decided success for this purpose. (See Appendix). All animals do not take to it at once (although some individuals do), but with some coaxing they soon will. It is well to remind the reader in this connection that such valuable feeds as alfalfa and ensilage are not relished at first by most animals, but that after a time, they are eaten with much relish.

As a hog and sheep pasture, Sweet Clover has been used with decided success in some of the Western States, notably Iowa and Wyoming, and as a pasture for cattle in Ontario. Mr. P. L. Case, of Aurora, York County, uses it for milch cows, and finds it to be excellent forage for this purpose, giving abundance of feed and a splendid milk flow. And the milk, in his experience, is not tainted. Here, however, experiences differ, as some report finding a bad taint given to the milk and to the butter made from it.

The great advantage of using Sweet Clover as a forage is its earliness, being some two weeks to a month ahead of alfalfa and the common clovers in regard to the time that stock can be turned on to it in the spring. Furthermore, it is not so susceptible to drought nor so likely to winter-kill, and also Sweet Clover as a forage plant, as a general experience, does not cause bloat as is the case with most other legumes. This is thought to be due to the presence of the coumarin. Some cases of bloat, nevertheless, have been reported.

Altogether, there is great promise for Sweet Clover as a pasture and hay crop.

Following are some figures relative to the composition of Sweet Clover from analysis of samples collected in 1914. Included in comparison is the composition of some other common pasture and hay crops.

TABLE L.—COMPOSITION OF SWEET CLOVER, AND OF SOME OTHER PLANTS FOR COMPARISON.

Note.—Figured on the dry basis

Kind of Crops.	Stage of Growth when Cut.	Ash. %	Protein. %	Fat. %	Soluble Carbo- hydrates. %	Fibre. %
Sweet Clover.....	First sign of bloom.....	8.92	15.80	3.02	43.81	28.45
Sweet Clover.....	One-third in bloom.....	6.48	14.65	2.75	41.52	34.60
Sweet Clover.....	In full bloom.....	6.55	12.30	2.52	43.53	35.19
Sweet Clover.....	First sign of bloom.....	9.04	16.20	2.91	44.55	27.40
Sweet Clover.....	One-half in bloom.....	9.62	16.10	3.21	38.42	32.65
Sweet Clover.....	In full bloom.....	7.63	15.40	3.15	38.12	35.70
*Alfalfa or Lucerne.....	Buds formed.....	8.59	19.11	4.23	39.80	28.18
*Alfalfa or Lucerne.....	One third in bloom.....	7.24	15.52	3.51	41.67	32.06
*Alfalfa or Lucerne.....	A little past full bloom.....	7.01	13.89	2.61	38.82	37.67
†Red Clover.....	In bloom.....	8.33	15.65	5.08	42.69	27.65
†Alsike.....	9.19	14.20	3.21	45.05	28.35
†Timothy.....	In full bloom.....	5.29	7.06	3.53	49.32	34.80

* Ontario Agricultural College Bulletin No. 111.

† American Analysis.

Note:—The last six samples were grown on the Ontario Agricultural College farm, while the first six samples were grown on private farms.

From the table it will be noted that Sweet Clover, like the other legumes given, is a splendid source of protein, that most expensive of animal nutrients, and for which our legumes are so highly prized (compare with timothy, a grass, included in the table for this purpose, with its low per cent. of protein). In this constituent Sweet Clover compares very favourably with alfalfa, red clover, and alsike; and in the other constituents, viz., ash, fat, soluble carbohydrates and fibre there is no appreciable difference. All of them are rich in fibre, the woody part of plants, and the least valuable of animal nutrients furnished by plants to animals. Altogether, no particular preference can be mentioned respecting any one of the four legumes listed in the table in regard to the percentage of food constituents furnished by them—Sweet Clover is equal to any of the others in all respects.

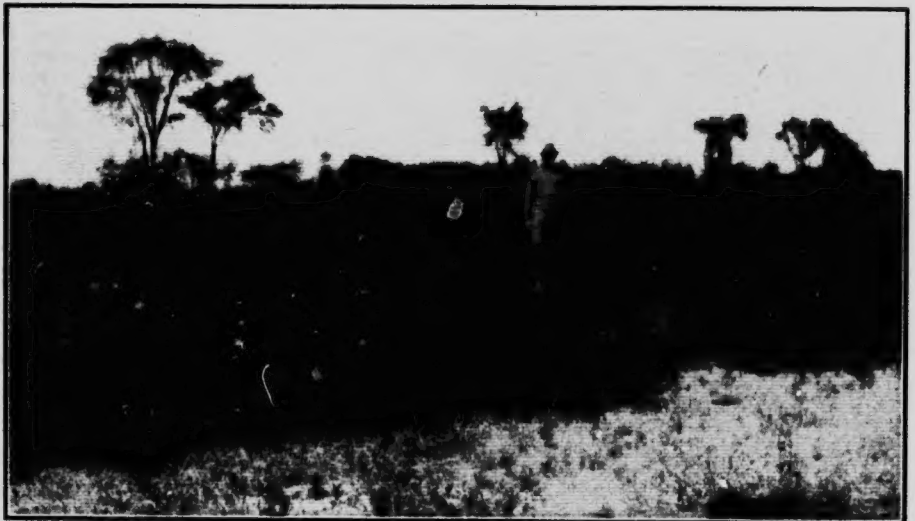


Fig. 3. A field of Sweet Clover on June 5th, ten days before it was cut for hay.

The percentage composition, however, does not tell everything. A most important point to consider in connection with the composition is the yield per acre, for it is only in this way that we can arrive at the comparative absolute amount of each of the food constituents obtainable from each of these given plants. It is a common practice among the farmers of some parts of this Province to cut the first crop of alfalfa for hay, let the second mature for seed, and pasture the balance of the season. If then, we take the weight of hay got from the first cutting of all the crops and the percentage composition given in Table I, and from this data calculate the weight of the various food nutrients supplied by each crop, we get the amounts found in Table II.

TABLE II.—YIELD PER ACRE OF HAY AND ITS CONTAINED NUTRIENTS AND FUEL VALUE, AS GIVEN BY SWEET CLOVER, ALFALFA, RED CLOVER, ALSIKE AND TIMOTHY.

Kind of Crop.	Yield of Hay Lbs. per Acre.	Ash Lbs. per Acre.	Protein Lbs. per Acre.	Fat Lbs. per Acre.	Soluble Carbo- hydrates Lbs. per Acre.	Fibre Lbs. per Acre.	Fuel Value Cals. per Acre.
1. Sweet Clover, first cutting.....	9,170	742	1,320	245	3,640	2,305	14,535,000
2. Alfalfa, first cutting.....	4,295	332	739	164	1,565	1,090	6,802,000
3. Alfalfa, first cutting.....	5,160	399	888	197	1,805	1,310	8,276,000
4. Red Clover	4,000	300	563	205	1,540	995	6,626,000
5. Alsike	4,000	331	511	116	1,625	1,020	6,359,500
6. Timothy	4,500	214	286	143	2,000	1,410	7,473,500

From the foregoing it will be seen that Sweet Clover furnishes a much larger amount of the animal nutrients than alfalfa or the other legumes and a very much greater quantity than does timothy. If we wish to take into consideration all the growth for the year, then Sweet Clover, red clover, and alsike should be credited with about one-half more of each of the nutrients. This is assuming that the second cutting will give on the average 50 per cent. of the weight of material in the first cutting. Alfalfa will give a second and third cutting, which, together, usually amounts to about three-quarters of the first. But even if we add 50 per cent. to the amount of each constituent derived from the first cutting of Sweet Clover, red clover and alsike, and 75 per cent. to that got from the first cutting of alfalfa, the Sweet Clover still furnishes a greater quantity of nourishment per acre than any one of the other crops included in the comparison.

It is, of course, difficult to compare crops in this way, unless they have all been produced under much the same conditions, Nos. 3, 4, 5, and 6, are the average yields as given on the College experimental plots, No. 3 being the average of seventeen years, and Nos. 4, 5 and 6, the average of five years' test. These figures have been obtained from the various reports of the Experimentalist. Samples 1 and 2 are the result of one year's experiment only, but they are of particular interest in that both the Sweet Clover and the alfalfa in this case were produced in the same season, and on the same soil and on adjoining plots, and are, therefore, strictly comparable. Sweet Clover has not been experimented with extensively on the College farm, but in the year 1892, it is reported that a yield of 13,760 lbs. of hay per acre, was obtained, a figure almost the same as that given for Sweet Clover in the table, should the second cutting be included.

There seems to be strong evidence that Sweet Clover is a very heavy producer of animal nutrients, exceeding most other farm fodder crops in this respect. It should compare favourably, therefore, with these other plants as a hay and pasture plant.

AS A BEE PASTURE. On account of the prolonged blooming season—from June until frost in the autumn—Sweet Clover proves an ideal honey plant. The honey obtained is colourless and of a fine flavour. The name of this plant, *Melilotus*, comes from the Greek and means honey or syrup of Lotus. Hence at the time the plant was named it was recognized as a leading source of honey.

AS A SOILING CROP. Abundant green feed is furnished by this plant, as much as 30.65 tons per acre being produced.* This is much higher than the average crop would be, but is an indication of the enormous amount of food furnished. Excellent silage can be made also.

AS A GREEN MANURE. The consensus of opinion, gleaned from the experience of practical farmers, is that Sweet Clover is one of the greatest of green manures, perhaps surpassing every other crop for this purpose. On account of the abundant growth produced, by ploughing it under a large amount of humus-forming material (dry matter) very helpful in ameliorating heavy clay and light, sandy soils, and for improving the water absorbing and holding power of all soils, is supplied to a soil. In Australia, raw white sand has, by the use of Sweet Clover as a green manure, been changed to a rich dark brown, almost black loam, in the course of five or six years.† Furthermore, this plant, in common with all other legumes,

*Ontario Agricultural College Report, p. 114.

†Ohio Bulletin, 244, p. 64.



Fig. 4. A field of Sweet Clover just past full bloom on July 30th, showing the immense growth produced in the second year. This stands five feet in height and would form abundance of humus if plowed under, besides supplying a great deal of nitrogen which it has absorbed from the air.



Fig. 5. Two typical plants of *Melilotus alba* taken on June 11th of the second year, showing the characteristic development of root and stem. The plant on the left was produced on a clay loam soil, and the one on the right on a light sand. The root is what is known as a tap root; the left-hand one is ten inches long, and the right-hand one thirty inches long. (See context for discussion of this.)

gathers nitrogen from the air and thus is an enricher of the soil in this element, the most costly and one of the most highly prized of fertilizer constituents. The roots extend to a great depth, reaching three and four feet or more in many cases, and are of a fleshy nature. These break and open the sub-soil, bring up mineral constituents from the lower reaches of the soil and beyond the reach of shallow-rooted plants, and on the death of the plant and the subsequent decay of these roots, a great deal of humus is left in the soil. The soil is also left more porous and open (especially valuable in heavy clay soils), and the surface soil is rendered much richer in mineral matter (potash and phosphoric acid) brought from the sub-soil by the long, deeply penetrating roots. We find that the quantity of these roots left in the top foot amounts to from one-half to one ton of dry matter per acre, and when we consider that it is possible to have from $1\frac{1}{2}$ to 6 tons of dry matter in the tops per acre to incorporate into the soil along with these roots it can easily be seen what immense value a crop of Sweet Clover ploughed under would have as a fertilizer alone, not to mention the marked physical improvement that would be effected at the same time. There would be carried into the soil by a crop of Sweet Clover in this way from 100 to 350 lbs. of nitrogen per acre, the greater portion of which has come from the air and is thus a distinct gain in fertility.

As an improver of barren and of worn-out and depleted soils there is abundant evidence to show that Sweet Clover is without a peer. Washed lands where the top fertile soil has been removed are soon again brought to a state of productivity by this plant, and, further, this plant appears to be about the only kind of vegetation which will establish itself on such situations.

Taken altogether, Sweet Clover, as a green manure and soil renovator and improver, promises well to become a boon to the Ontario farmer when once the present prejudice stigmatizing it as a weed and as a useless plant is overcome. This can only be done, of course, by familiarization and trial.

Following is a table showing the amount of humus-forming and fertilizing material found in Sweet Clover. The season in which these samples were taken (1914) was very dry during the months of June and July in this district, and therefore, the quantities given are much below the amount that would be given in an average season. However, the figures shown will give some idea regarding the value of Sweet Clover as a manure.

TABLE III.—DRY MATTER (OR HUMUS-FORMING MATERIAL) AND FERTILIZING CONSTITUENTS IN SWEET CLOVER, AS FOUND IN TOPS (STEMS AND LEAVES) AND ROOTS (IN TOP FOOT OF SOIL) AND IN TOTAL CROP (ROOTS, STEMS AND LEAVES),
AT TWO DIFFERENT STAGES OF GROWTH AND ON TWO TYPES OF SOIL.

No.	Stage of Growth.	Part of Plant.	Lbs. of Dry Matter per Acre.	Percentage of				Lbs. per Acre of			
				Nitrogen N	Phos- phorus P ₂ O ₅	Potas- sium K ₂ O	Calcium CaO	Nitrogen N	Phos- phorus P ₂ O ₅	Potassium K ₂ O	Calcium CaO
1	Flower buds just forming.....	Tops.....	5,860	2.79	.561	2.31	2.23	163.5	32.9	135.4	131.0
2	Flower buds just forming.....	Roots.....	2,015	1.57	.344	1.46	1.14	31.6	6.9	29.4	23.0
		Total Crop.....	7,875					195.1	39.8	164.8	154.0
3	Seed well filled.....	Tops.....	6,255	1.92	.437	1.57	2.00	120.0	27.3	98.2	125.0
4	Seed well filled.....	Roots.....	2,215	1.40	.239	1.33	.775	31.0	5.3	29.5	17.2
		Total Crop.....	8,470					151.0	32.6	127.7	142.2
5	Flower buds, just forming.....	Tops.....	3,320	2.71	.551	2.23	2.12	90.0	18.3	73.0	70.4
6	Flower buds just forming.....	Roots.....	898	1.57	.311	1.55	.843	14.1	2.8	13.9	7.6
		Total Crop.....	4,218					104.1	21.1	86.9	78.0
7	Seed well filled.....	Tops.....	7,280	2.50	.449	1.50	1.80	181.5	32.6	108.9	131.0
8	Seed well filled.....	Roots.....	1,810	1.22	.265	1.29	.752	22.1	4.8	23.4	13.6
		Total Crop.....	9,070					203.6	37.4	132.3	144.6

Note.—These samples were grown on private farms, the first four on sandy soil and the last four on clay loam.

It will be noted that the amount of dry matter or humus-forming material in the stems and leaves ranges between 3,320 to 7,260 lbs. per acre, and in the roots from 898 to 2,215 lbs. per acre; and from 4,218 to 9,070 lbs. per acre in the total crop. The amount of nitrogen in the stems and leaves ranges between 90 to 181.5 lbs., and in the roots from 14.1 lbs. to 31.6 lbs. per acre; and in the total crop from 104.1 to 203.6 lbs. per acre. A great part of the dry matter and a large part of the nitrogen are derived from the atmosphere and thus make a distinct addition, in fertility, to the soil. Phosphorus ranges from 18.3 to 32.9 lbs. in the tops and 2.8 to 6.9 lbs. in the roots, per acre; potassium from 73.0 lbs. to 135.4 lbs. in the tops per acre, and from 13.9 lbs. to 29.5 lbs. per acre in the roots; and the calcium from 70.4 lbs. to 131 lbs. in the tops, and to from 7.6 to 23.0 lbs. in the roots, per acre. In the total crop phosphorus ranges between 21.1 to 39.8, potassium from 86.9 to 164.8, and calcium from 78. to 154. lbs. per acre, respectively. A large part of these three constituents is brought from the sub-soil by the long roots and are eventually left in the surface soil which is thereby enriched greatly for shallow-rooted plants, such as the grasses. They are, furthermore, left here in a much more available form than that in which they originally existed.



Fig. 6. Sweet Clover growing on blow sand, which is otherwise practically bare of vegetation, except for a few horsetail and Canada thistle. This sand is rich in lime (calcareous).

OTHER USES OF SWEET CLOVER.*

In China, *Melilotus officinalis* is used as a fibre plant for the manufacture of rope; used as a vegetable in much the same manner as we use spinach; and is also utilized for the preparation of coumarin, its principal aromatic flavour, this being used in perfumery. In India it is also used as a vegetable. In Switzerland the dried flowers of *Melilotus Azureus* are powdered, worked up into a paste and used in curd to give an odour or flavour to Schapziger cheese. The French use the *Melilotus alba* as a textile plant in the manufacture of cloth and cordage. It is also probable that Sweet Clover could be used for the production of pulp to be used in the manufacture of paper.

*Ohio Bulletin, 244.

SOILS ADAPTED TO THE PRODUCTION OF SWEET CLOVER.

Sweet Clover seems to have no particular choice of soil and in this respect is unlike other plants. Consequently, it is widely adaptable, and extensively disseminated. It is found growing on heavy clay and on sharp, clear sand and on all soils intermediate between these. The only things which seem to prevent it introducing itself is sourness or acidity in the soil or an overcharge of alkali, particularly black alkali. Neither of these conditions are prevalent in Ontario. It is a lime-loving plant, like all other legumes, and does best when lime is abundant in the soil—it reaches perfection of growth on rotten limestone as in old limestone quarries, and along railway tracks and on gravel knolls where lime is usually plentiful. A soil lacking in lime would have to be given an application of this material in the form of air-slaked lime, or ground limestone, before it would produce Sweet Clover, or for that matter, any other legume, successfully.



Fig. 7. A nearer view of same as in Fig. 6, showing the luxuriant growth, the clover being rank and standing thirty inches high on the 11th June, in spite of the fact that the season in this particular district was exceedingly dry.

An advantage attached to Sweet Clover is that it will grow on very wet or very dry soils. It is to be found taking a stand where the soil is practically water logged and also on soils which are too dry to produce any other kind of provender.

THE HANDLING OF SWEET CLOVER.

FOR SECURING A STAND. The most essential thing to observe in seeding Sweet Clover is to have the seed bed thoroughly compacted, with just sufficient loose soil on top to allow of the seed being properly covered. It may be sown in the spring, alone or along with a nurse crop, much like red clover, or in late summer or early fall, like alfalfa. Of the hulled seed, about 20-25 lbs. per acre should be used, and of the unhulled seed about five pounds more. Much of the seed may not germinate the same year on account of the hard seed coats, hence a generous application of seed is advisable. When a nurse crop is used the latter should not be sown too thickly, else it will tend to smother the young clover seedlings.

Sweet Clover may not do well on soil that has never produced it before, because of the lack of the nodule forming bacteria. In this case it would be advisable to inoculate the seed by means of a culture obtained from the Ontario Agricultural College, or with soil from a place which has been or is producing Sweet Clover.

FOR HAY. Sweet Clover must, like alfalfa, be cut at the proper time, or else it becomes too woody and stemmy for first-class hay. The proper stage for cutting seems to be about the time the first blossom is ready to appear. The growth of the first year produces the best hay, as in its first season's growth this plant does not produce bloom and has not the same tendency to become fibrous as it has in the second year; but the second year's growth will give good hay if taken in time. Two crops can be secured the second year. However, in taking off the first crop, care must be exercised not to cut too low but to raise the cutting bar to such a height that some of the lower branches will be left uncut, otherwise the second crop will be either destroyed or greatly interfered with. If cut for hay the fall of the first season, it should in no case be mown until the crown sprouts begin to appear on top of the roots about an inch below the surface of the soil.



Fig. 8. Just after the first cutting of Sweet Clover has been removed for hay on June 15th. Observe that it has been cut high enough to leave abundance of young growth to produce the second crop. This is very essential.

Sweet Clover is hard to cure on account of the fairly large stems and because of the fact that it has to be cut at a time when there is a considerable amount of moisture present in it. Furthermore, if care be not exercised during the curing process a great part of the leaves will be lost and in this way the better part of the hay be wasted. Any severe handling at this time, such as tedding and raking, should be done, therefore, when the hay is still a little tough. However, any one familiar with the process of curing alfalfa will understand this thoroughly for this plant is much like Sweet Clover in these respects, being hard to cure and difficult to handle without considerable loss of leaves.

The following two tables (IV and V) show the effect of age on the proximate composition of Sweet Clover; also the effect on the digestibility of the protein, and on the yield of total nutrients and digestible protein per acre. They will, therefore, give some idea as to the proper time to cut this plant for hay-making purposes.

TABLE IV.—SHOWING THE COMPOSITION OF SWEET CLOVER, AND THE DIGESTIBILITY OF ITS PROTEIN, TAKEN FROM TWO DIFFERENT TYPES OF SOIL, AND CUT AT SIX DIFFERENT STAGES OF MATURITY.

Note.—Figured on air-dry basis.

Sample.	Date of Cutting.	Stage of Maturity and Height in Inches.	% Water.	% Ash.	% Protein (N x 6.25)	% Fat.	% Soluble Carbo-hydrates.	% Fibre.	Digestive Co-efficient of the Protein.	Fuel Value per 100 grams Cal.
A	June 5	Before bud formation, 24 in.....	7.26	9.08	19.19	3.07	39.33	22.07	88.1	359
A ₁	June 11	Buds formed, 28 in.....	7.15	8.23	16.98	3.09	38.85	25.70	86.6	363
A ₂	June 18	First bloom appearing, 33 in.....	6.44	8.35	14.75	2.83	41.02	26.61	84.0	364
A ₃	June 25	One-third in bloom, 36 in.....	6.99	6.02	13.63	2.56	38.65	32.15	82.7	370
A ₄	July 7	In full bloom, 44 in.....	5.96	6.16	11.56	2.37	41.05	33.00	78.5	373
A ₅	July 30	Seed filled, 55 in.....	7.07	5.76	11.16	2.15	40.96	33.50	77.7	371
B	June 5	Before bud formation, 24 in.....	6.68	9.30	19.45	3.11	39.30	22.16	86.4	361
B ₁	June 11	Buds formed, 30 in.....	7.78	9.04	16.19	3.20	39.66	24.13	83.7	368
B ₂	June 18	First bloom appearing, 36 in.....	7.39	8.37	15.00	2.69	41.19	25.36	82.7	369
B ₃	June 25	One-half in bloom, 40 in.....	7.68	8.88	14.88	2.96	35.46	30.14	83.1	367
B ₄	July 7	Full bloom (falling), 51 in.....	6.93	7.10	14.31	2.93	35.52	33.21	80.9	363
B ₅	July 30	Seed filled, 60 in.....	6.47	5.09	14.63	2.37	36.03	35.41	81.9	375

Note.—The first six samples were grown on sand (calcareous); the last six samples on clay loam—all on private farms.

The foregoing table shows the rapid rise in percentage of fibre or woody matter which takes place during progress of the plant toward maturity. The increase in one case is from 22.07 to 33.5 (= 11.43) and in the other case from 22.16 to 35.41 (= 13.25) per cent.; and associated with this rise in fibre is a corresponding decrease in the percentage of all the other nutrient constituents—ash, protein, fat and soluble carbohydrates. This change takes place most noticeably after the bloom begins to appear.

Now there are no objections to the changes noted above as taking place in composition during approaching maturity up to a certain limit, because the total amount of nutrients are not changed in so far as absolute quantity of yield per acre is concerned as can be seen by consulting Table V below. In fact for ruminant animals particularly, a more or less bulky and fibrous ration is highly desirable as aiding to fill the large and capacious stomach, in the secretion and distribution of the digestive juices and thereby digestion, and in assisting to maintain the general health of the animal. But if the fibre becomes too prominent, particularly for non-ruminants, the value of the food is lowered not only because more food has to be eaten in order to ingest a sufficient quantity of the other nutrients (which entails, of course, consumption of energy), but because the animal in its endeavor to digest the difficultly digestible fibre, expends a great deal of energy needlessly. It is claimed that the amount of energy obtainable from fibre after it is digested is not equal to the energy expended in its digestion. This latter is notably true of fibre from more or less mature plants because it has then become quite hardened and coarse, whereas in young plants, the fibre is still sufficiently succulent to lend itself more or less easy of digestion by the enzymes of the alimentary tract.

Not only does the fibre increase in quantity during advancing maturity, but the protein, the most valuable nutrient constituent of the plant and for which substance the plants of the legume family are so highly prized, becomes less digestible. The digestibility of the protein in the *A* samples was lowered from 88.1 to 77.7 and in the *B* samples from 86.4 to 81.95. That is, out of 100 lbs. of protein eaten, that many pounds of protein, viz.: 88.1, 77.7, 86.4 and 81.95—would be digested and absorbed. In the first case, therefore, out of every 100 lbs. of protein in the Sweet Clover 11.9 lbs. and 13.6 lbs. would be wasted, respectively, should the clover be cut just before the budding stage; whereas 22.3 lbs. and 18.05 lbs. respectively, would be excreted unabsorbed should the clover be cut at the stage when the plant has gone to seed. This, of course, is a costly waste.

TABLE V.—THE TOTAL WEIGHT OF NUTRIENTS, AND THE AMOUNT OF DIGESTIBLE PROTEIN, FURNISHED BY ONE ACRE OF SWEET CLOVER, AT SIX DIFFERENT STAGES OF MATURITY.

No.	Date of Cutting.	Stage of Maturity.	Green Weight Lbs. per Acre.	Air-dry Weight Lbs. per Acre.	Lbs. per Acre of					Digestible Protein Lbs. per Acre.
					Protein.	Fat.	Soluble Carbo- hydrates.	Fibre.	Ash.	
B	June 5	Just before flower buds had formed.....	15,940	2,876	548	87.6	1,107	624	202	473
B ₁	June 11	Flower buds formed.....	12,100	3,297	534	105.5	1,107	795	298	447
B ₂	June 18	First bloom appearing.....	7,865	3,547	532	95.4	1,461	809	297	440
B ₃	June 25	One-half in bloom.....	11,610	3,654	544	108.2	1,296	1,102	303	452
B ₄	July 7	Full bloom.....	17,550	5,078	727	149.0	1,803	1,686	361	568
B ₅	July 30	Seed filled and beginning to ripen.....	13,920	7,703	1,136	184.0	2,798	2,749	305	961

Looking over Table V it will be noted that although Table IV shows a decrease in the percentage of ash, protein, fat and soluble carbohydrates, still the yield of these substances per acre is largely increased as the plant goes toward maturity. This, needless to say is explained by the great increase in dry matter during that time, an increase amounting to 4,947 lbs. (7,763—2,816) or 175 per cent. between June 5th and July 30th. This might indicate that the later stage would be the desirable time for taking the crop off for hay. But if the figures showing green weight and air-dry weight be compared, it will be noted that the plant changes from a very succulent state to a very non-succulent state in passing from the pre-flowering stage to the seeding stage, a fact which when coupled with the large increase in fibre (4.4 times) during the same time, indicates that the plant changes from a tender herbaceous succulent state at the time just before bloom appears, to a hardened woody dry state at the time the seed is developed, a change from a tasty, appetizing condition to a tasteless, non-attractive one. This change is gradual but progressive from the first to the last.



Fig. 9. The second crop in full bloom on July 30th, a month and a half after the first crop was removed for hay. This second crop is reserved for seed.
This is the same field as shown in Fig. 8.

Summing up the information imparted by the data contained in Tables IV and V, it can be stated that the proper time to cut Sweet Clover for hay, is before full bloom; preferably, as before stated, about the time the first blossoms are to appear. At this time a reasonable amount of nutrients has been accumulated in the plant per acre, it is still succulent and tender but not too succulent to make it excessively difficult to cure, and lastly, the bitter principle, coumarin, which exists most abundantly in the flowers and which gives the strong smell and objectionable taste to the hay, is largely gotten rid of by thus cutting before the bloom is on.

FOR PASTURE. To be used successfully for pasturage Sweet Clover must be pastured sufficiently heavy and close to keep from getting too far advanced and to keep abundance of fresh and tender growth coming on at all times. If it gets ahead of the stock it becomes too coarse and fibrous to be relished. Should such happen it is a wise plan to clip it back to a height of 6 to 8 inches. Some men of experience claim that stock should be turned on when the plants have reached a height

of about 4 inches. For permanent pasture some plants must, however, be allowed to go to seed the second year, enough to reseed the field; or seed must be sown. If this is not done the plants, being biennial, will run out at the end of that time.

The nutrient value of this plant as a pasturage is shown by a reference to the tables showing its composition.

FOR SEED PRODUCTION. For the production of seed the first crop of the second year can be allowed to go to maturity, although it would perhaps be more economical and practical to take the first cutting off for hay and to allow only the second crop to mature for seed. It should be harvested when three-quarters of the seed pods become dark. Harvesting can be done with a binder and further operations carried on the same as with other grain crops. Handling should be avoided when the straw is very dry as the seed will shell badly at such a time and much would be lost. Threshing and hulling should be carried on, however, when thoroughly dry. A yield of from 2 to 8 bushels per acre can be obtained.



Fig. 10. The second year's growth, five feet high and well laden with seed, on July 30th. Some bloom still in evidence, although most of the seed is well filled and beginning to ripen.

CONCLUSION.

After a general survey of the whole field wherein Sweet Clover could serve as a farm crop we cannot but conclude that this plant gives much promise of value. It is a plant which is widely distributed and widely adaptable. By reference to publications on the subject, by correspondence, by conversation with different farmers and men engaged in agricultural work, and by personal observation and experience we find this plant to be growing in all countries and on all types of soil. Furthermore, in addition to its great adaptability, we find it actually to have found a place on the farm in many foreign countries and in a few sections in our own country. Not only has this usefulness been found but a knowledge of this fact is spreading. At this time in the province of Ontario, quite a number of farmers are trying out this new crop on their own farms in order to demonstrate to themselves whether or not it has any virtue. It is beyond the experimental stage with some

farmers already, and these, who have now grown it on their farms for several seasons, are convinced and are enthusiastic for its future. Soon there will be a more widespread knowledge concerning the agricultural value of this plant.

Up to date Sweet Clover seems to have immense value as a soil improver and herein, perhaps, lies its main virtue. It will establish itself on very poor soils, soils which are naturally poor or which have become so by a system of exhaustive cropping or otherwise, and on soils which would otherwise produce practically no growth, such as alkali soil and blow sand, and give surprising yields. Not only does it give growth where otherwise there would practically be none, but, what is just as important, it eventually puts these same soils into such an improved state of fertility and tilth that other crops which before were impossible can then be successfully produced. This will be of inestimable value to our worn out or impoverished lands and to our bad lands sections.

But, in addition to its green manuring value, much value is attached to Sweet Clover as a pasture and hay crop. This is of particular value in very dry climes or seasons or to those sections of low fertility, for here, otherwise, practically no provender would be available and nothing would exist but a barren waste. Furthermore, there are other values attached, particularly that as a bee pasture or honey plant.

Finally, although there appears to be no question as to the value of Sweet Clover, conservatism is to be urged. It is never wise to take up a new thing in a hurry. Everything has to be learned in regard to this new plant and failure might be the result of some very simple mistake due to inexperience. If failure results the logical outcome, of course, is condemnation, and condemnation under these conditions is very often undeserved. It is desirable, therefore, that small areas only be seeded to this plant in the beginning until its management and value be determined, and then it can be gone into with greater assurance or discarded altogether, as the farmer concerned may see fit.

APPENDIX.

Containing evidence of the world-wide distribution of Sweet Clover and its great adaptability to different soils and soil conditions and to differences in climate. Also containing opinions, based on experience and observation, in regard to the agricultural uses of Sweet Clover and the best methods of handling it for obtaining satisfactory results.

FOREIGN.*

ENGLAND: Both species (*M. alba* and *M. officinalis*) are common throughout England. Considered too coarse for hay. Thrives on poor sandy soil.

SCOTLAND: Known well in Scotland, though not considered of much agricultural value. A small amount is a valuable admixture in hay as it imparts to the whole a sweet agreeable odour.

GERMANY: Both species are growing in Germany and are used for binding the soil on banks and slopes and also as a green manure.

RUSSIA: Sweet Clover is an excellent soil-manuring plant and a nitrogen collector. Manuring by means of plowing under Sweet Clover gives the subsequent crop a dark green tinge, such as is given by Chili Saltpetre (Sodium nitrate). This plant to be grown with success needs, above all, the presence of lime in the soil. This plant contains coumarin which imparts to the milk and butter of cows that have eaten it a fine taste.

AUSTRIA: Farmers easily produce good crops of Sweet Clover, giving feed for their cattle, especially in years of scarcity of other forage.

HUNGARY: *Melilotus officinalis* prospers and provides good pasture for sheep on the driest and most barren slopes, such as occur along the Adriatic. By reason of its modest requirement of water it can be advantageously grown on very dry soil where other legumes cannot thrive.

ITALY: When used as a hay care should be taken to cut it at the exact period of maturity for if cut too soon it is hard to dry, and if cut late it is tough. Adapted to mediocre dry calcareous (rich in lime) soils, or poor dry soil, such as is found in the dunes.

BELGIUM: Serviceable for planting in poor gravelly soils. It affords pasture for sheep and is used as a fertilizing plant.

SWITZERLAND: White melilot is much used in this country for agricultural purposes, particularly as hay. Farmers are very appreciative of it.

INDIA: A promising weed. The want of green fodder is keenly felt in parts of the central provinces from December to June. *Melilotus alba* germinates early in November, grows to a height of 3 feet and is relished by both cattle and horses.

CHINA: It is eaten with relish by pigs, which thrive on it.

AUSTRALIA: Although it is a good grazing plant, its principal virtue lies in its power to fertilize and bring into use poor, sandy soil. Raw white sand in the course

*Taken from Ohio Bulletin, No. 244.

of five or six years has been changed into a rich dark-brown, almost black, loam capable of growing good crops of oats, lucerne, etc., by the use of Sweet Clover. The reason for this lies in the power of the melilot as a legume to absorb nitrogen from the air and deposit it in the soil.

SOUTH AMERICA: Sweet Clover grows in wet or moist places, in lowlands and deserted river bottoms. Animals do not leave it in view long except in inaccessible places.

UNITED STATES.

***ILLINOIS:** "Its value is beginning to be recognized by many of the farmers of this State both as a fodder and hay crop and as a soil renovating crop."

***WISCONSIN:** "It grows luxuriantly along the roadsides throughout Wisconsin. The stalks are so watery that it cannot be cured easily into hay. I understand that if it is in a pasture and cattle are forced to eat it by being left on a small area for a considerable length of time that they become accustomed to it."

***INDIANA:** "While it grows luxuriantly along the roadsides and in all kinds of waste places, we have found it hard to start under cultivation. So far I am not convinced that this plant can take the place of alfalfa as a forage crop, or such rapid growing annuals as cowpeas and soy beans for soil improvement in this part of the country."

†**OHIO:** "Most of these cultivated plants (red clover, rye, cowpeas, soy beans, buckwheat) will not thrive under the adverse conditions where their use as humus-forming materials is most needed. Therefore, a hardy, vigorous growing, soil-poverty withstanding plant is needed. Sweet Clover is such a plant and also possesses the distinct advantage of being a legume, *i.e.*, a nitrogen gathering plant. It also affords a nutritious herbage for horses, cattle, sheep and swine. . . . It thrives best in soils rich in lime and requires inoculation in order to do well under some conditions."

‡**NEBRASKA:** "The general experience of farmers is that stock must acquire a taste for Sweet Clover before eating it readily. Very little difficulty is experienced, however, in getting stock to eat it and when they have once acquired the taste it affords excellent pasture. To make good pasture it should be grazed sufficiently close to prevent a coarse growth. . . . In addition to increasing the available nitrogen, Sweet Clover has an abundant root development, which greatly increases the organic matter in the soil. . . . On very thin or wornout soils an entire crop of Sweet Clover can profitably be plowed under for green manure. . . . Being shallower rooted, Sweet Clover does not dry out the subsoil to as great a depth as does alfalfa, and for this reason succeeding crops in the rotation are not so likely to suffer from lack of moisture."

§**MISSOURI:** "A great deal of interest is being manifested in this crop by Missouri farmers and, while some still consider it a pest, others are apparently obtaining good results with it. . . . The chief value of Sweet Clover for Missouri conditions is as a green manuring crop. . . . Some farmers regard it

*Extracts from letters received.

†Ohio Bulletin, 244.

‡Nebraska Extension Bulletin, 22.

§Missouri Experimental Station pamphlet.

as practically worthless as a hay or pasture crop, while others have apparently had good success with feeding it."

***KENTUCKY:** In seeding Sweet Clover "the ground should be thoroughly firmed down and the seed covered to a depth of about one-half inch. . . . Sweet Clover does not stand the winter well unless it makes a good growth before cold weather. For this reason it is not safe to sow it late."

†**IOWA:** "As a whole, the use of Sweet Clover for green manuring purposes in Iowa is strongly to be advocated. . . . It grows best on soils rich in lime and it has been claimed that its roots decay much more rapidly than those of other legumes."

CANADA.

PRINCE EDWARD ISLAND: "Sweet Clover is not a native in this Province. It is found, however, growing as a weed in very limited quantities. The species occurring is *Melilotus alba*. Where found it grows vigorously, but I know of no instance where it is grown as a crop. . . . There are some farmers who show some interest in it, but as a general rule the plant is regarded altogether in the light of a weed."—W. Davison, late Instructor in Field Husbandry, Dept. of Agri., Charlottetown, P.E.I.

NOVA SCOTIA: "Sweet Clover occurs in this Province to a very limited extent; in fact, to such a limited extent that very few farmers know the plant except by name. Owing to the advertising which this plant has received during the past winter, a number of farmers throughout Nova Scotia have this past spring seeded an acre or more with this crop. I am of the impression that they will be disappointed in results, but there is no use in anticipating the matter as it is being given an extended test and we will be able to observe facts later."—M. Cumming, Principal, College of Agriculture, Truro, Nova Scotia.

NEW BRUNSWICK: "White Sweet Clover and Yellow Sweet Clover both occur quite commonly in this Province, the former the more abundantly of the two. Very little use has been made of either as agricultural plants, though a great many farmers have become interested in them lately on account of the publicity which has been given them by the agricultural press. The White Sweet Clover may be quite extensively tried during the next few years. A few farmers have tried it already, but, so far as I can learn, with rather indifferent success. It is found growing chiefly along railroad embankments and roadsides, but, though looked upon as a wild plant, it is not regarded as a harmful weed."—R. Newton, Director of Agricultural Schools, Province of New Brunswick.

QUEBEC: "We have grown the white flowered, that is, the *Melilotus alba*, at the College for five or six years and have found it extremely valuable as a renovator of poor soils. Ordinarily we get from 10 to 14 tons of green crop per acre, and one year we obtained as high as 22 tons to the acre on poor land. It has always been our practice to plow this crop under when it reaches the height of about 4 feet as it will decompose quite readily if turned under at this stage. When found growing wild, however, it not infrequently exceeds 6 feet in height. The yellow flowered (*Melilotus officinalis*) is not grown to any considerable extent in this Province, but one finds occasional plants in the fields and by the roadside. Very little Sweet

*Kentucky Bulletin, 178.

†Iowa Circular, 10.

Clover is found growing wild north and west of the line from Hawkesbury to Valleyfield, but as one gets east it has been my observation that the amount increases, and in the vicinity of St. Hyacinthe, Quebec, there are large tracts given over almost wholly to the growing of this crop. Here the land is very heavy and wet and it appears that the Sweet Clover is the only clover that will come through satisfactorily. Farmers in this district use it largely for pasture and also for hay. In this Province the man who does not have Sweet Clover on his farm always regards it as a most noxious weed, while the man whose fields are completely over-run with it speaks in high praise of it. For the past six or seven years I have taken the position that if properly handled Sweet Clover can be used to great advantage, especially in renovating our poorer and heavier soils."—L. S. Klinck, late Prof. of Cereal Husbandry, Macdonald College, Quebec.

"We have it growing in abundance on the railway, in fence corners and old pasture, etc., about Ste. Annes. My experience with it as a pasture crop extends over only one year. Last year I rented a farm in the vicinity with the idea of using it for pasture. It contained a mixture of grass for the most part, but on about 12 acres nothing but Sweet Clover was growing. The cattle did not go to pasture very early so that a very rank growth had been made by the clover when they were turned in. For the greater part of the season the clover was allowed to grow and, as far as I could see, served no purpose other than for brushing off the flies through the summer. This was not true, however, of the scattered plants and bunches of plants mixed with the other grass, because they seemed to eat the tops off this, although there was no particular desire shown for it. Later in the fall, and especially after the first frost, which arrived in early September, the cattle seemed to take to the Sweet Clover and in spite of the fact that there was no scarcity of grass generally. Although most of it was becoming somewhat coarse they seemed to relish the Sweet Clover very much, and the result was that before they were brought in the twelve-acre forest of Sweet Clover had been completely demolished and, while we are not able to furnish figures in regard to gains, etc., there is no doubt in my mind that the cattle did extremely well when they were eating the clover almost exclusively. I may say they started at first by picking off the tops, gradually stripping the leaves and stalks as well. We have not had a chance to try out sheep, but I am inclined to think that the sheep would take to the Sweet Clover kindly and do well on it. . . . I am anxious for more experience before I make up my mind definitely in regard to it for pasture, but certainly our results of last year suggest value. The plant on this particular farm is the white flowered variety. . . . We have not tried making it into hay. This year I had hoped to make a test of it for silage purposes, but as yet we have not been able to manage it."—H. Barton, Professor of Animal Husbandry, Macdonald College, Quebec.

MANITOBA: "Sweet Clover is prevalent nearly all over the Province, but more especially is it prevalent in the Red River Valley on our heaviest soil. There are two varieties, one white, the other yellow. The white one is the more vigorous grower, occasionally reaching the height of eight feet; the yellow variety does not grow so luxuriantly.

"I had occasion to visit a district about fifty miles south of this city (Winnipeg), where a large amount of Sweet Clover grows, and I had the first experience of it being used as pasture for cows. I told you in my last letter that I had no knowledge of any of our domestic animals using this plant, in any shape as fodder, but on the trip I have mentioned I personally saw a large number of cows and young stock feeding on the Sweet Clover.

"The farmers told me that they did not find it necessary this year to cut down, rake up and burn this plant as they had in previous years, their cattle having apparently got over their dislike for the plant.

"I asked several what results they got from the use of this plant as a milk producer, and asked if it kept the cattle in good condition. The reply was, that their cattle milked better and that they got a higher percentage of butter fat than when the cattle feed on the prairie pasture, and they kept in good thrifty condition. I might add that there is a great deal of curiosity in our more progressive farmers' minds as to what would be the possible outcome of sowing this as fodder, and I believe we will have a good many experiments tried in the near future to decide whether it will be beneficial to grow this plant to any great extent for fodder. This plant may prove a very valuable friend to the people of this Province when it comes to be cultivated as a fodder crop, and also for its beneficial effect on our heavy soil in the Red River Valley."—R. G. O'Malley, Provincial Noxious Weed Inspector.

MANITOBA: "There is more or less Sweet Clover scattered throughout the Province chiefly as a roadside weed. From personal observations I would say that it is principally of the white variety (*M. alba*), although I have also seen the yellow variety (*M. officinalis*) growing side by side with the white. In such cases, however, the *M. alba* appeared to possess the more vigorous growth. From enquiries I have made I would say that this plant owes its introduction to the fact that a few farmers believed it to possess value as a forage plant and sowed small areas of it years ago, in some cases as long as twenty years. From these sources it has been allowed to spread along the roadsides and waste places and has been looked upon as a weed, although not a noxious one. Sweet Clover has also been sent in on several occasions lately as a weed occurring in alfalfa, in this case being mostly the *M. officinalis*. The plants sent in have been very healthy, vigorous specimens. I am not aware that the plant has been used to any extent as hay, pasture, etc., but I have no doubt that a number of men have sown it this year with the idea of using it in some such way. . . . I believe that there have been some areas as large as ten acres sown this year. There has not been any work done on the College Farm with Sweet Clover, but we have a plot sown to it this year in the hope of obtaining some knowledge as to its adaptation to our conditions."—Jas. H. Bridge, Dept. of Field Husbandry, Manitoba Agri. College, Winnipeg.

SASKATCHEWAN: "None of the species of *Melilotus* is found in this Province, except in isolated cases. I know of several small towns in which the yellow-blossomed sort, *Melilotus officinalis*, is found growing as a weed along the sides of the road and in other waste places. *Melilotus alba* may also be seen in similar conditions but in smaller quantities. The former has often been observed as an impurity in alfalfa. Neither of these is used as a farm crop in this Province, nor have they been used to any extent as a green manure crop. Both are looked upon with disfavour, not because they have proven themselves weeds or unfit for forage, but because of the rather unsavoury reputation they both possess."—J. Bracken, Professor of Field Husbandry, University of Saskatchewan, Saskatoon.

BRITISH COLUMBIA: "With reference to Sweet Clover, would say that this plant is growing quite luxuriantly in several different parts of this Province. It does not encroach on the cultivated areas, and is regarded with indifference. We, however, are of the opinion that it will prove to be very valuable in several districts, principally for manure. So far as I have observed, there are no large areas, but the distribution is wide, chiefly in the interior of the Province. Up to the

present time have not noticed it growing on Vancouver Island or on the Lower Mainland. We intend to use the crop for green manuring on several of our Farm Management Stations next season. The most common variety is the *Melilotus alba*. I have noticed but one patch of the *Melilotus officinalis*."—J. C. Ready, Soil and Crop Instructor, Dept. of Agri., Victoria, B.C.

"*Melilotus alba* is the leading species in this Province. I am pleased to say that it is not at all common in this district, and where found is treated very much the same as any other weed. It grows best, probably, in the Upper Country, where land is irrigated. It is found all along the irrigation ditches and a certain amount of it in the alfalfa fields, where it is treated as a weed and a bad one. The general impression in the country is against it, with the exception of the bee people. . . . When one sees it grow and going to seed along the irrigation ditches in the open range, untouched by cattle, it would appear that it is not relished as much by stock as is alfalfa."—P. H. Moore, Superintendent Agassiz Experimental Farm, Agassiz, B.C.

ONTARIO.

In the reports from counties wherein representatives of the Department of Agriculture are stationed and which represent all parts of the Province only two report Sweet Clover as not occurring, viz., the districts of Kenora and Thunder Bay. All others report it as occurring, as a rule both varieties, *alba* and *officinalis*, being mentioned. It appears to be growing on all types of soil from the light to the heavy and from the dry soils to those in need of drainage. It is rarely mentioned as a bad weed, and seldom stated to be found growing in cultivated areas in the wild state. Following are extracts from the letters of several Representatives:—

Essex: "There is a great deal of Sweet Clover growing in this county along the roadside and in uncultivated fields, but there is no one yet that I know of growing it commercially. It grows exceptionally well and to the best advantage here on clay loam. It has been deemed a bad weed until recently, when a number of farmers are beginning to realize that if handled properly it may be used to considerable advantage in the way of regenerating wornout soil. While a certain amount can be noticed growing in cultivated fields, still where a reasonable rotation is followed it gives no trouble in this respect."—W. E. J. Edwards.

Kent: "There are both varieties of Sweet Clover, the yellow and the white, with a tendency in the heavy clay sections for yellow to predominate. It is found in all parts of the county, in the gravels, loams and heavy clays, but it is, if anything, more heavily established in the clay districts. It is generally deemed a weed, very troublesome on roadsides, but not to any extent where proper rotation and cultivation methods are in vogue. We have fields that have been uncultivated for some years completely overrun with the yellow variety. In fact, in some cases it is being pastured very profitably. There has as yet, as far as I have been able to ascertain, none of it been cut for hay, nor have there been any definite steps taken up on farms to introduce it as a crop."—W. T. Hunter.

Elgin: "Both White and Yellow Sweet Clover are found here, growing best on well-drained clay soils. It does, however, make some growth on light soils. By many this clover is considered a weed of only slight importance. It is certainly growing spontaneously in waste lands and in some cultivated fields.

"Mr. John Lunn, Fingal, is the only man I know who is cultivating the plant. He finds White Clover the better, grows it in a mixture with red clover, alsike and blue grass and finds that as a pasture horses and cattle are fond of it and pigs and

sheep prefer it to alfalfa. Mr. Lunn has been growing Sweet Clover for two years and recommends it as a pasture entirely irrespective of the fact that he is a bee keeper. When sowing it alone Mr. Lunn used 15 lbs. of seed to the acre, from which he got three loads at first cutting and one bushel of seed at second cutting. When pastured it is ready for use early in June."—P. E. Culverhouse.

Northumberland: "In reply to yours of the 24th ulto. *re* Sweet Clover in this county, I cannot say that it is very strongly established here. There is some of the white variety (*Melilotus alba*) growing along roadways, especially those nearer the railroads, and in unused places, but it is not very common through Northumberland and the yellow variety (*Melilotus officinalis*) is comparatively scarce. It is not found growing spontaneously in cultivated fields and is not counted as a bad weed. The soil where I have seen it is clay and clay-loam in nature. . . . Recent praises of Sweet Clover and an observation that some cattle eat it along the roadways have led a few whom I know to contemplate trying it on a small scale as a fodder crop."—R. S. Beckett.

Carleton: "We find Sweet Clover growing more or less generally throughout the county. It grows on the roadsides, in waste places and cultivated lands. While quite common throughout the county it is not cultivated. On the farm of Lorne Groves at Kinburn, Sweet Clover appeared in one of his fields after seeding down with clover and grass seed about five years ago. It has continued to spread spontaneously throughout this ten-acre field since that time, and Mr. Groves has already taken off and cured for hay a crop of Sweet Clover averaging two tons, or better, for the ten-acre field. The Sweet Clover was, last year, in his grain crop and he found that the stock was very fond of the straw from that field on account of the large amount of Sweet Clover it contained. Mr. Groves is at present feeding the green Sweet Clover to his horses, and states that 'they are fond of it.' . . . The variety of Sweet Clover which Mr. Groves has taken off for hay is the Yellow Sweet Clover (*Melilotus officinalis*)."—W. D. Jackson.

Manitoulin: "Following your circular *re* Sweet Clover, I might say that there is no Sweet Clover cultivated here and only a small amount of it growing wild. It is growing mostly on sandy or gravelly soils and is deemed a weed, though not a very bad one."—I. F. Metcalf.

Durham: "Sweet Clover grows in various parts of the county, both the white and yellow varieties, but is usually recognized as a weed. I have seen it growing on soils varying from light sand to heavy clay; on the roadside, and in uncultivated fields and also in cultivated fields. In so far as I know, the plant is not being cultivated in this county."—R. S. Duncan.

Simcoe: "Sweet Clover has not been cultivated and in its natural state is not growing in sufficient quantities in this county to cause people to regard it as a weed. In some places waste land is infested to a certain extent and odd plants are found at times in meadow land. I have seen some of the yellow variety, but the white is much more common."—J. Laughland.

Haldimand: "Sweet Clover grows in every township of Haldimand. We have both the yellow and the white-flowered varieties, the white being much more common as it is much hardier. The yellow appears only in occasional small patches. We find Sweet Clover growing on all the different kinds of soil in our county, some of which in the vicinity of Dunnville is very sandy, but the majority of which is heavy clay. It seems to be most abundant on the heavy clay soil, and particularly on the

roadsides. . . . Sweet Clover is by a large majority of people deemed a troublesome weed. This last year or two, however, a few people of the county have realized the value of Sweet Clover and are growing it commercially. For some years a number of people have grown Sweet Clover which has been plowed in with a good growth was attained to give a seed bed of alfalfa. This spring quite an acreage of Sweet Clover was planted in this county, the main object being to get a crop of hay as well as seed. The majority of the growers claim that the seed crop will be the most profitable as they expect that for a few years at least there will be a very large demand for the seed in Ontario, principally for experimental purposes. It is claimed that Sweet Clover is very easily killed if cut close to the ground just as it has come into bloom. It is confined mostly to fence corners, roadsides and waste places, but it creeps into fields occasionally, particularly in our alfalfa fields and, judging by the reports from a large number of samples which we had tested in Ottawa last year, the seed of Sweet Clover is quite prevalent in alfalfa seed grown in this county."—H. M. King.

OPINIONS OF SOME ONTARIO FARMERS.

"I do not consider Sweet Clover a noxious weed. I have fifteen acres of the yellow variety and there is a good second crop on it now which I may thresh. The soil is clay loam. Cattle and horses eat it as well as alfalfa. It does not taint the milk."—Lorne Groves, Kinburn.

"I sowed Sweet Clover last April on light loam, alongside of red clover. The latter did not catch. I seeded this same field to alfalfa two years ago and lost all my seed.

"I do not consider Sweet Clover a noxious weed. Horses relish it."—T. M. Caton, Cherry Valley, 1914.

"I seed to Sweet Clover in the spring as you would ordinary clover. The seed bed is prepared the same and a nurse crop of oats or barley is used. The fifteen acres which I seeded this spring has a good catch and is growing very well. I expect it will be up into the oat and barley sheaves when they are cut.

"I do not consider it a bad or noxious weed. Even if it will not all die on plowing the roots will be taking some nitrogen from the air and that is what we want it to do. There is one way that it can be killed effectually, and that is by cutting in June with the mower or other implement which will cut it close to the ground. This I have observed time and again when we got the seed in other grass seed.

"It will grow on all kinds and conditions of soil, but seems to grow best on well-drained loam. No other plant will be found growing on as poor soils as it will.

"Our animals will not refuse to eat it. In fact, when I turned our cattle in on it last year after the grain crop was harvested they ate it in preference to the abundance of June grass that was growing along the fences and in a waste portion of the field. However, there may be some animals that would require a little education to make them eat it, but the effort would be small on the part of the teacher. I believe that it is as good a feed as is alfalfa, but cannot speak definitely on that point. It does taint the milk and butter, but the taint is anything but offensive. The taint is sweet and pleasant and will leave the butter after it has been made about three days.

"I have seeded with the white variety and much prefer it to the yellow.

"As Sweet Clover is only a biennial there will be only two years' crop off it unless it be allowed to go to seed. The first cutting of the second year should be

made in June just as the first blossoms appear. If it is left later I notice that it has a tendency to get tough and woody. It should be cut in June with the binder so that the stubble will be left about six inches high. In this way one can get a second cutting in the year. If it is cut in June with the mower the whole field will be killed and the second cutting gone. If it grows well during the first year one may be able to take a cutting in the fall and use the mower without hurting it any. I notice that it should be sowed rather thickly so that the stalks will not grow too thick and coarse. What I seeded this year was at the rate of fifteen pounds per acre."—Thomas H. Binnie, Sec. Grey County Board of Agr., Priceville.

"It is not a bad or noxious weed, for the simple reason that as you plow it under it is dead and done for, and does not spread over the fields like other weeds.

"It grows on any soil except those devoid of lime, thrives on blow away sand, stony land or stiff clay, conditions too adverse for other plants to thrive in; best results are obtained on good loam soils.

"As hay it is as good as alfalfa; pastured while young is good for all kinds of stock and yields a continuous supply of nutritious herbage which is a good milk producer; is a good honey plant; its one drawback as a plant for green feeding is the short time the plant would remain in the best condition for such purpose, against which it re-crops directly. While maturing it is a complete cover, so much so that it smothers almost all noxious weeds, including Canada thistles and sow thistles. For green manuring it excels by adding more humus than any other green manures.

"Animals are not always fond of it at first, but soon acquire the taste and ever after prefer it to other foods; they thrive on it as well as on alfalfa or other clovers; no taint has been noticed on milk or butter from its use.

"We grow the white-flowered variety only, preferring it for its vigour and sureness of crop.

"Sweet Clover is indifferent to the time of sowing and the preparation of the soil beyond any other field crop. It may be successfully sown in winter, spring, summer or fall; must not be covered deep, harrowing is hurtful. For pasture or seed 12 pounds per acre is enough, and for hay 16 pounds.

"If sown alone a crop of hay may be cut the first year, but late; if with other crop some pasture will be afforded the first year and it will fully crop the second year.

"Our method has been to sow with grain, pasture in the fall and let go to seed the second season, with satisfactory results. We know of it being cut early for hay and good seed crop obtained after, the same season. In fact, we know no other crop so indifferent to its soil, cultivation, seeding and treatment and that would produce such results."—Wm. Linton, Sr., Aurora.

"I can give you a little more information about Sweet Clover than last year. It grew well, and averaged between three and four tons to the acre. We sowed 5 lbs. on one-fifth of an acre, and off that fifth of an acre cut three-quarters of a ton of dry hay and have been feeding a horse on it. The horse is working hard every day and is in good condition, feeding off the hay from that plot since the 6th of June.

"All we have is now from two to three feet high and white with blossom; we expect a nice bunch of seed. I sowed three acres this year and will sow fifteen acres next spring. It will grow where alfalfa is a failure. I sowed the larger plot where the year before I had sowed \$22.00 worth of alfalfa and that was no good, and the Sweet Clover was three feet high in June.

"All stock will eat it readily."—T. M. Caton, Cherry Valley (Aug. 3rd, 1915).

"Our seed turned out well. We cut it with the binder and had 15 bags of seed, each weighing 250 pounds, and sold it at \$14.00 per bushel.

"This year's crop has been cut for hay, 33 big loads. Some we cut too late and it killed out, but what we sowed with the buckwheat last year is coming on for seed, being about two feet high now.

"Our stock prefer it to any other feed and seldom leave the barn, although the other pasture is good."—Rocliffe Lindon, Vandorf (July 27th, 1915).

"I sowed some Sweet Clover on hillsides on a grazing farm a year ago this spring. It made an early start this spring and the stock seemed to be very fond of it. They had a big range of natural grass to feed on, but there seemed to be something about the Sweet Clover they liked, for they kept it grazed off short and they had abundance of natural grass. I never had cattle put on so much gain in weight before. I seeded fourteen acres on fall wheat this spring; it is about six inches high now and expect it will give good pasture after the wheat is removed. The different farmers who have tried it in this section think it will prove a very valuable crop."—Julius Holm, Cherry Grove Farm, Walkerton.